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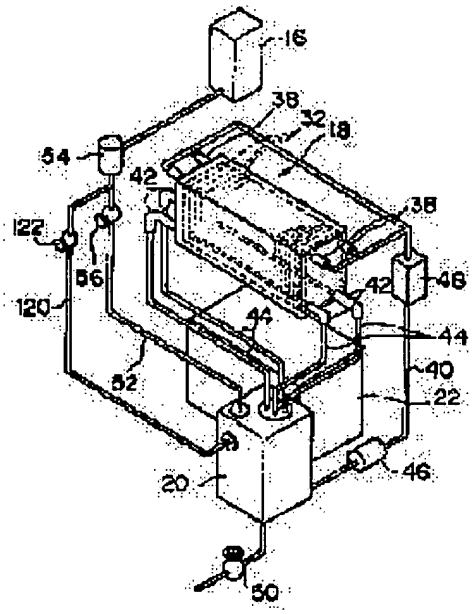
(71)Applicant : SANYO ELECTRIC CO LTD
(72)Inventor : FUJIO AKIRA
MAKIHARA KATSUYUKI
HATAYAMA TATSUJI

(54) FUEL CELL APPARATUS

(57)Abstract:
PROBLEM TO BE SOLVED: To exhaust water in a fuel cell apparatus to the outside according to weather conditions after finishing operation, thus preventing the apparatus from freezing.
SOLUTION: After finishing the operation of a fuel cell system, when a freezing preventing button is pushed, a temperature sensor judges whether atmospheric temperature is less than freezing temperature (degree of frost) or not. If it is less than freezing temperature, a solenoid valve 122 and a solenoid valve 50 are opened, and a circulation pump 46 is driven for constant time. By opening the solenoid valve 122, a main tank 20 communicates with the atmosphere, and water is exhausted from the solenoid valve 50 installed in the bottom of the main tank 20. The circulation pump 46 is driven, water collected in a water supply pipe 40, a fuel cell module 18, and a water exhaust pipe 44 is returned to the main tank 20. Water in a water circulation line in the fuel cell system is exhausted to the outside through the main tank 20.
Therefore, water to be frozen does not exist, and the breakage of the system can be prevented.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] Fuel cell equipment characterized by providing the following. The solid-state macromolecule type fuel cell which the hydrogen in fuel gas is made to react to the basis of mediation of water electrochemically with the oxygen in the atmosphere, and generates electrical energy. A water supply means to supply water in the water of a tank to the aforementioned solid-state macromolecule type fuel cell. A drainage means to drain the water of the aforementioned solid-state macromolecule type fuel cell to the aforementioned tank. The aforementioned solid-state macromolecule type fuel cell, the aforementioned tank, the aforementioned water supply means, and a scupper means to discharge the water which piles up in the aforementioned drainage means.
[Claim 2] the fuel cell equipment according to claim 1 carry out that came out and the aforementioned scupper means was constituted with the scupper valve prepared in the aforementioned tank, the air valve prepared in the aforementioned tank, a temperature detection means detect outside air temperature, and the control means which carry out the predetermined-time drive of the aforementioned water-supply means while opening the aforementioned scupper valve and the aforementioned air valve after an operation end based on the signal from the aforementioned temperature detection means as the feature
[Claim 3] the fuel cell equipment according to claim 1 carry out that came out and the aforementioned scupper means was constituted with the by-path pipe which connects the scupper valve prepared in the aforementioned tank, the air valve prepared in the aforementioned tank, a temperature detection means detect outside air temperature, the aforementioned water-supply means, and the aforementioned scupper valve, and the control means which open the aforementioned scupper valve and the aforementioned air valve based on the signal from the aforementioned temperature detection means after an operation end as the feature
[Claim 4] the by-path pipe which connects the scupper valve with which the aforementioned scupper means was prepared in the aforementioned tank, the air valve prepared in the aforementioned tank, and the aforementioned water supply means and the aforementioned scupper valve, the scupper switch which makes the aforementioned scupper valve and the aforementioned air valve open wide after an operation end, and the fuel cell equipment according to claim 1 with which it is characterized by to be come out and constituted

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention makes a hydrogen fuel react electrically with the oxygen in the atmosphere, and relates to the fuel cell equipment which generates electrical energy.
[0002]
[Description of the Prior Art] In a solid-state macromolecule type fuel cell, all the chemical energy that the supplied fuel has is not transformed into electrical energy, and, in many cases, the chemical energy more than a half is transformed into heat energy.
[0003] While carrying out humidity of the macromolecule ion exchange membrane, a solid-state macromolecule type fuel cell is cooled, and the water which is not consumed is made to drain to a storage-of-water tank through a drain pipe with fuel cell equipment by supplying water to the fuel circulation way of a solid-state macromolecule type fuel cell through a feed pipe from a storage-of-water tank, in order to discharge this generated heat besides a solid-state macromolecule type fuel cell.
[0004] If such fuel cell equipment of composition is installed in the outdoors of a cold district and fixed time operation is not carried out, the water which piled up into the solid-state macromolecule type fuel cell, the storage-of-water tank, the feed pipe, and the drain pipe is frozen, operating becomes impossible or there is a possibility that equipment may be damaged by the expansion pressure at the time of water being frozen.
[0005]
[Problem(s) to be Solved by the Invention] Let it be a technical problem to offer the fuel cell equipment which can avoid un-arranging according to water freezing this invention in consideration of the above-mentioned fact.
[0006]
[Means for Solving the Problem] In invention according to claim 1, a solid-state macromolecule type fuel cell makes the hydrogen in fuel gas react to the basis of mediation of water electrochemically with the oxygen in the atmosphere, and generates electrical energy. The water of a tank is supplied [water] for it and cooled with a water supply means by the solid-state macromolecule type fuel cell. Moreover, excessive water is drained through a drainage means to a tank from a solid-state macromolecule type fuel cell.
[0007] The scupper means is established, and after an operation end, if a scupper means is operated, the water which piles up in a solid-state macromolecule type fuel cell, a tank, a water supply means, and a drainage means will be discharged by this fuel cell equipment outside.
[0008] Equipment seems for this reason, for operating not to become impossible or not to damage, since the water to freeze does not exist even if it installs fuel cell equipment in the outdoors of a cold district and stops fixed time operation.

[0009] a scupper means comes out with the scupper valve prepared in the tank, the air valve prepared in the tank, a temperature detection means to detect outside air temperature, and the control means which carry out the predetermined-time drive of the water supply means while opening a scupper valve and an air valve based on the signal from a temperature detection means at the time of the operation end of fuel cell equipment, and consists of invention according to claim 2
[0010] That is, at the time of the operation end of fuel cell equipment, if a temperature detection means detects outside air temperature which water freezes, it will emit a signal to control means. Thereby, control means carry out the predetermined-time drive of the water supply means, while opening a scupper valve and an air valve. For this reason, the water in a tank is discharged through a scupper valve, and the water in a water supply means, a solid-state macromolecule type fuel cell, and a drainage means flows back to a tank compulsorily, and is discharged in the scupper valve shell exterior.
[0011] Thus, by setting up according to a weather condition, so that a scupper may be performed automatically, a handling mistake is lost and the reliability of equipment increases.
[0012] a scupper means comes out with the by-path pipe which connects the scupper valve prepared in the tank, the air valve prepared in the tank, a temperature detection means to detect outside air temperature, a water supply means, and a scupper valve, and the control means which open a scupper valve and an air valve after an operation end based on the signal from a temperature detection means, and consists of invention according to claim 3
[0013] That is, at the time of the operation end of fuel cell equipment, if a temperature detection means detects outside air temperature which water freezes, it will emit a signal to control means. Thereby, control means open a scupper valve and an air valve. For this reason, the water in a tank is discharged through a scupper valve, and the drainage of ponded water of the water in a solid-state macromolecule type fuel cell and a drainage means is carried out in an operation of gravity, and it is discharged through a tank outside. Furthermore, the water in a water supply means is discharged from a scupper valve through a by-path pipe outside in an operation of gravity.
[0014] It becomes unnecessary thus, to carry out the predetermined-time drive of the water supply means like invention of a claim 2 by forming a pie path pipe.
[0015] a scupper means comes out with the by-path pipe which connects the scupper valve prepared in the tank, the air valve prepared in the tank, and a water supply means and a scupper valve, and the scupper switch which makes the aforementioned scupper valve and the aforementioned air valve open wide after an operation end, and consists of invention according to claim 4
[0016] After an operation end, only by turning on a scupper switch, a scupper valve and an air valve are opened wide, and the water in equipment is discharged outside and can simplify a system with this composition.
[0017]
[Embodiments of the Invention] As shown in drawing 1 and drawing 2 , the fuel cell equipment 10 concerning the 1st gestalt is stored in the box-like receipt case 12 by which water proofing was carried out. The receipt case 12 is divided into three steps of upper and lower sides, and the control unit 14 and the sub tank 16 are contained by the upper case. Moreover, the fuel cell module 18 is contained by the middle of the receipt case 12, and the main tank 20 and the inverter 22 are further contained by the lower berth.
[0018] Moreover, the hydrogen bomb 24 is contained by the front face of the receipt case 12, and can be easily exchanged by opening door 12A.
[0019] As shown in drawing 3 and drawing 4 , it has the electrode / poly membrane zygote by which the fuel cell module 18 joined the cathode 30 to the front face of macromolecule ion exchange membrane (illustration ellipsis), and joined the anode 26 to the rear face. This electrode / poly membrane zygote are put on a bipolar plate, a cell 32 is constituted, two or more sheet (this example 50 sheets) laminating of this cell 32 is carried out, and the fuel cell module 18 is

constituted.
[0020] Moreover, the joint pipe 38 is connected above the fuel cell module 18, and water is supplied to it through a feed pipe 40 to the fuel cell module 18 from the main tank 20 mentioned later. This water plays the role to which the fuel cell module 18 is cooled and humidity of the macromolecule ion exchange membrane is carried out again.
[0021] On the other hand, the L character-like joint pipe 42 is attached under the fuel cell module 18. It is the composition which a drain pipe 44 is connected to the joint pipe 42, and discharges water from the fuel cell module 18.
[0022] As shown in drawing 2 , the drain pipe 44 has resulted in the gaseous-phase section A which penetrated ceiling wall 20A of the sealed main tank 20, and was formed between Water W and ceiling wall 20A which stored water. Thus, the water in a drain pipe 44 flows back into the main tank 20 completely by not putting in the down-stream mouth of a drain pipe 44 into Water W, but taking the method which carries out a drainage of ponded water.
[0023] Moreover, the feed pipe 40 is connected under the side attachment wall of the main tank 20. And water is supplied to water through the cooling filter 48 (refer to drawing 3) by the circulating pump 46 to the fuel cell module 18. Furthermore, the solenoid valve 50 for scuppers opened and closed with a control unit 14 is formed in the bottom wall of the main tank 20.
[0024] On the other hand, as shown in drawing 3 and drawing 4 , the sub tank 16 contained by the upper case of the receipt case 12 is connected with the main tank 20 through the supplement pipe 52. the water level with which the conveying pump 54 and the solenoid valve 56 are arranged by the supplement pipe 52, and the pars basilaris ossis occipitalis of every fixed time and the main tank 20 was equipped — in response to the signal from a sensor 58, the main tank 20 is supplemented with pure water from the sub tank 16
[0025] Moreover, the air vent pipe 120 is connected above a solenoid valve 56, and it is open for free passage with the main tank 20 in it. The solenoid valve 122 for air vents opened and closed with a control unit 14 is formed in this air vent pipe 120.
[0026] Next, an operation of the fuel cell equipment concerning this gestalt is explained. If the shut-down button 84 of a control panel 82 shown in drawing 1 is pushed, fuel cell equipment 10 will start, and as shown in drawing 4 , the hydrogen gas with which the pressure declined through the regulator 60 and the solenoid valve 62 from the hydrogen bomb 24 will be supplied to the anode 26 of the fuel cell module 18.
[0027] If hydrogen is supplied to an anode 26, hydrogen will emit an electron, will serve as a hydrogen ion, and will move with water in the inside of macromolecule ion exchange membrane. This hydrogen ion that moved reaches a cathode 30, reacts with the oxygen in the air supplied by the multiblade fan 64 from the outside, and generates water. Consequently, an electron flows through an external circuit from an anode 26, and the power of a direct current occurs.
[0028] While water is supplied to water through a feed pipe 40 to the fuel cell module 18 from the main tank 20 and a damp or wet condition is maintained for macromolecule ion exchange membrane at this time so that a hydrogen ion can move without resistance in the inside of macromolecule ion exchange membrane, cooling of the fuel cell module 18 is performed. And the water which was not consumed results in the joint pipe 42 by gravity.
[0029] Four drain pipes 44 are connected to this joint pipe 42, the independent drainage system is constituted, and water can be made to flow back from the fuel cell module 18 to the main tank 20 certainly.
[0030] The hydrogen gas of a minute amount which was supplied to the fuel cell module 18 and did not react on the other hand is sent to the gaseous-phase section A of the main tank 20 through piping 68. This main tank 20 is sealed and the hydrogen gas of the minute amount guided here results in a mixer 74 through a needle valve 72 through the hydrogen exhaust pipe 76. Moreover, the air which was supplied to the fuel cell module 18 and did not react results in a mixer 74 through the air exhaust pipe 77. In a mixer 74, after the hydrogen gas of a minute amount is fully diluted by air, it

is emitted to the atmosphere.
[0031] moreover, the water level prepared in the bottom when the water consumed by the fuel cell module 18 evaporated and the water level of the main tank 20 fell — a sensor 58 sends a signal to a control unit 14 A control unit 14 opens a solenoid valve 56, drives a conveying pump 54, sends the pure water which stored water on the sub tank 16 to the main tank 20 through the supplement pipe 52, and makes continuous running possible.
[0032] On the other hand, the direct current power generated by the fuel cell module 18 is changed into voltage predetermined with DC to DC converter 94 which constitutes an inverter 22, is changed into an alternating current from a direct current by the AC/DC inverter 96, is sent to the ac-output terminal 98, and supplies fixed ac power. Moreover, the solid-state macromolecule type fuel cell 10 of this form is a self-conclusion type, and power is not supplied from the exterior.
[0033] For this reason, it has the rechargeable battery 78 which is the power source used for during starting. This rechargeable battery 78 is charged by the charging circuit 80 by the dump power at the time of power generation.
[0034] Next, anti-freeze operation mode is explained with reference to the flow chart of drawing 5 . After pushing again the shut-down button 84 (refer to drawing 1) of a control panel 82 and terminating operation of fuel cell equipment 10, if the anti-freeze button 126 is pushed, it will change to anti-freeze operation mode at Step 200.
[0035] Next, outside air temperature has it judged by the temperature sensor 124 prepared in the outside of the receipt case 12 in Step 202 whether it is below a freezing point (freezing point). If affirmed, a solenoid valve 122 and a solenoid valve 50 will be wide opened at Step 204, and a fixed time drive of the circulating pump 46 will be carried out at Step 206.
[0036] Water is discharged from the solenoid valve 50 from which the main tank 20 was formed in the bottom of the main tank 20 through the atmosphere by opening a solenoid valve 122. Moreover, a circulating pump 46 drives and the water which piled up in the feed pipe 40, the fuel cell module 18, and the drain pipe 44 flows back to the main tank 20.
[0037] The water in the water cycle system in fuel cell equipment 10 is discharged through the main tank 20 by this outside. For this reason, the water to freeze stops existing, operating becomes impossible or it is lost that equipment is damaged.
[0038] Next, the fuel cell equipment concerning the 2nd gestalt is explained. With the 2nd gestalt, as shown in drawing 6 and drawing 7 , the delivery side of the circulating pump 46 arranged at the feed pipe 40 is connected to the scupper pipe 130 in which the solenoid valve 50 was formed in the bypass pipe 128. This bypass pipe 128 gets down, and serves as inclination, and water flows by gravity. Moreover, the tube diameter of the bypass pipe 128 is made sufficiently smaller than the tube diameter of a feed pipe 40 (in this example, it is considering as the ratio of 10:1), and serves as a design to which the water of the main tank 20 cannot flow easily at the time of operation of fuel cell equipment 133.
[0039] Next, an operation of the 2nd gestalt is explained. If the shut-down button 84 of a control panel 82 is pushed again, operation of fuel cell equipment 10 is terminated and the anti-freeze button 126 is pushed with the 2nd gestalt as well as the 1st gestalt, it will change to anti-freeze mode.
[0040] Next, outside air temperature has it judged by the temperature sensor 124 prepared in the outside of the receipt case 12 whether it is below a freezing point (freezing point). Affirmation opens a solenoid valve 122 and a solenoid valve 50 wide.
[0041] Thereby, water is discharged from the solenoid valve 50 by which the main tank 20 was formed in the bottom of the main tank 20 through the atmosphere. Moreover, the drainage of ponded water of the water which piled up in the fuel cell module 18 and the drain pipe 44 is carried out to the main tank 20 in an operation of gravity, and it is drained from a solenoid valve 50. On the other hand, the water which piled up in the feed pipe 40 flows into the bypass pipe 128 by gravity, and is discharged through a solenoid valve 50 in the immediate exterior.

[0042] Thus, by forming the bypass pipe 128, like the 1st gestalt, since it becomes unnecessary to make a circulating pump 46 drive, a running cost can be reduced.
[0043] Next, the fuel cell equipment concerning the 3rd gestalt is explained. With the 3rd gestalt, after pushing again the shut-down button 84 of a control panel 82 and terminating operation of fuel cell equipment 10, the scupper switch 132 (refer to drawing 1) is turned on by judgment (the weather report which becomes freezing point-ization has come out tonight) of an operator.
[0044] If this scupper switch 132 is turned on, a solenoid valve 122 and a solenoid valve 50 will be wide opened a predetermined time (set up by the capacity of the main tank 22) by timer control, and the water in the water cycle system of fuel cell equipment will be discharged like the 2nd form outside.
[0045] After an operation end, only by turning on the scupper switch 132, since the water in fuel cell equipment is discharged outside, with this composition, a system configuration can be made simple. In addition, the direction performed somewhat automatically although draining is also considered as a valve of manual system deals with a solenoid valve 50,122, and a mistake is lost.
[0046]
[Effect of the Invention] Water is frozen and fuel cell equipment seems not to break down, since this invention was considered as the above-mentioned composition and the water in fuel cell equipment is discharged after an operation end outside according to a weather condition.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the external view of the fuel cell equipment concerning the 1st gestalt.
[Drawing 2] It is the cross section which looked at the interior of the fuel cell equipment concerning the 1st gestalt.
[Drawing 3] It is the outline perspective diagram of the water cycle system of the fuel cell equipment concerning the 1st gestalt.
[Drawing 4] It is the block diagram of the fuel cell equipment concerning the 1st gestalt.
[Drawing 5] It is the flow chart which shows an operation of the fuel cell equipment concerning the 1st gestalt.
[Drawing 6] It is the cross section which looked at the interior of the fuel cell equipment concerning the 2nd gestalt.
[Drawing 7] It is the outline perspective diagram of the water cycle system of the fuel cell equipment concerning the 2nd gestalt.
[Description of Notations]
14 Control Unit (Control Means)
18 Fuel Cell Module (Solid-state Macromolecule Type Fuel Cell)
20 Main Tank (Tank)
40 Feed Pipe (Water Supply Means)
42 Joint Pipe (Drainage Means)
46 Circulating Pump (Water Supply Means, Scupper Means)
44 Drain Pipe (Drainage Means)
50 Solenoid Valve (Scupper Valve, Scupper Means)
122 Solenoid Valve (Air Valve, Scupper Means)
124 Temperature Sensor (Temperature Detection Means)
128 By-path Pipe (Scupper Means)
132 Scupper Switch (Scupper Means)

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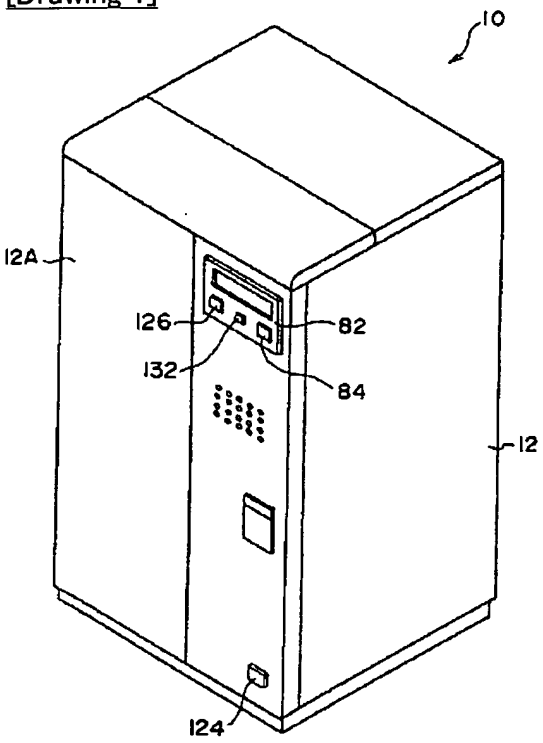
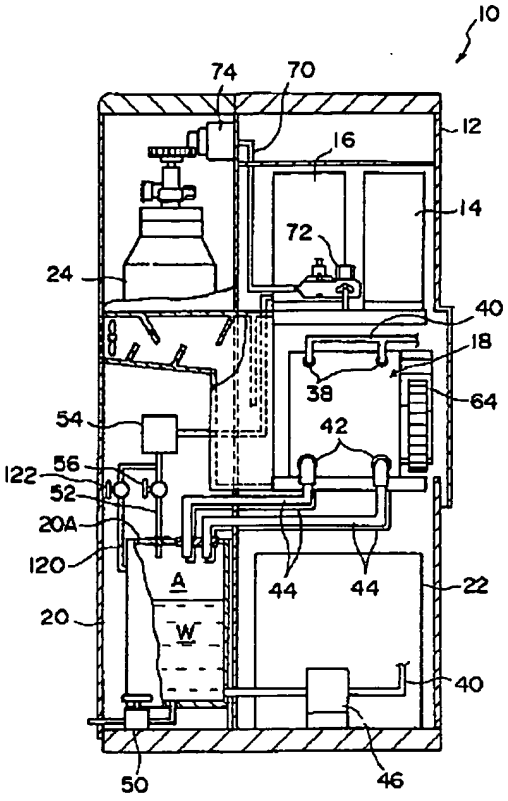
DRAWINGS

[Drawing 1]



[Drawing 2]



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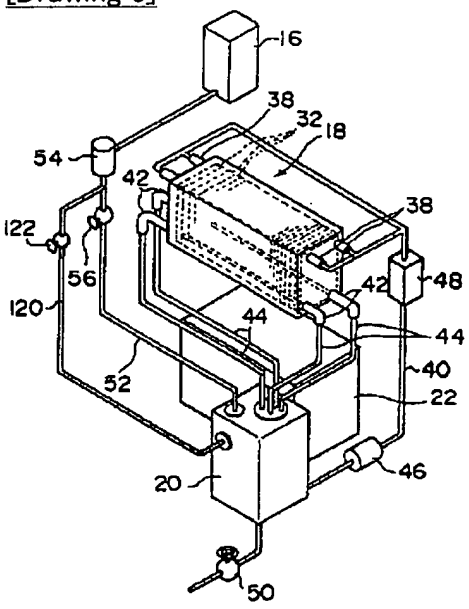

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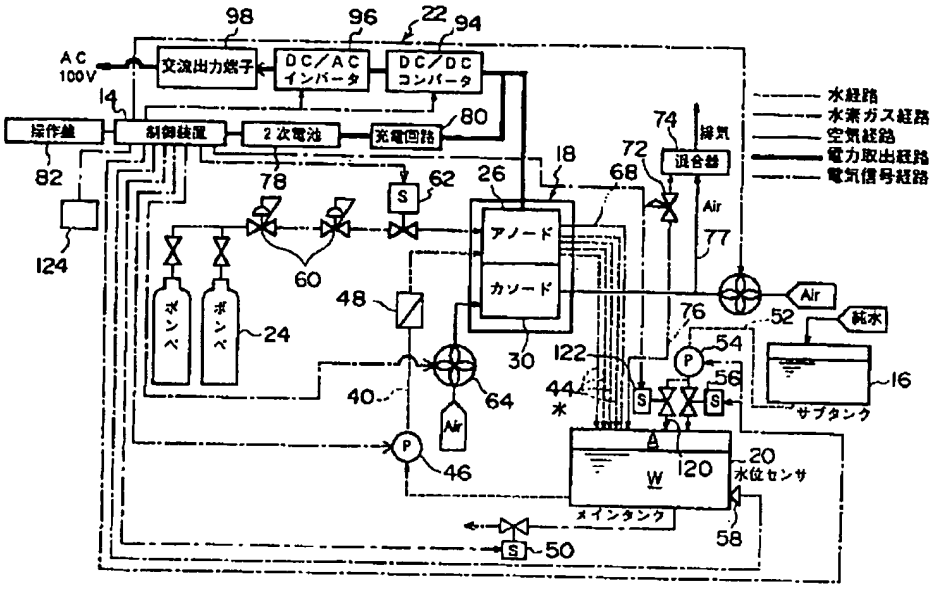

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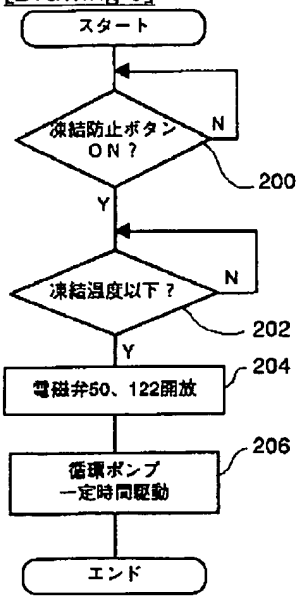

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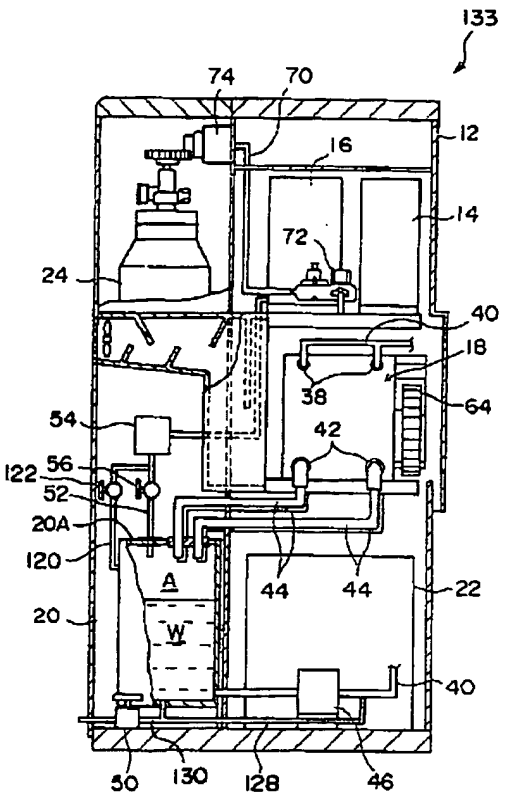
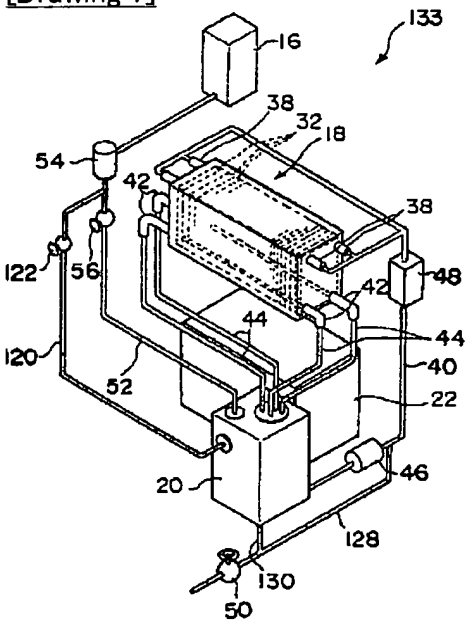


[Drawing 7]



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